THE LONGITUDINAL AND LATERAL DISTRIBUTION OF LOADS IN OPEN-DECK RAILWAY BRIDGES

BY

THEIN WAH

B.S.(Hons.), University of Rangoon, 1941
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AN ABSTRACT OF A THESIS

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This thesis is an investigation of the longitudinal and lateral distribution of loads in certain types of railway bridges in common use; the aims of the investigation are to make a theoretical analysis and to furnish formulas and tables summarizing the results. The predictions of the theory are compared with test results wherever these are available.

The terms "longitudinal" and "lateral" arise basically out of the kinds of problem encountered in the design of two types of railroad bridges. These are the two general types investigated.

The first type, designated Type I, consists of a large number of transverse beams supported on heavy longitudinal edge girders. Longitudinal diaphragms, extending the full length of the bridge, are attached to the transverse beams. For proper design of the transverse beams it is necessary to know how the wheel loads are distributed among them. Hence the problem of interest is the longitudinal (that is, parallel to the direction of traffic) distribution of a train of wheel loads. Three variations of Type I are investigated, the variations depending on the number and position of the longitudinal diaphragms.

The second type, designated Type II, consists of a number of equally spaced, identical longitudinal beams. Timber ties are placed across the top of these beams. Transverse diaphragms, extending the full width of the bridge, are connected to the longitudinal beams at intervals. For proper design of the beams it is necessary to know how the wheel loads are distributed among them. Hence the problem of interest is the lateral (that is, perpendicular to the direction of traffic) distribution of a train of wheel loads. Three variations of Type II are analyzed, consisting of four, five and six longitudinal beams respectively.

In addition to the above analyses an investigation is made of a gridwork consisting of two systems of parallel girders interconnecting at right angles. This is a logical generalization of the two types mentioned above.

It is found that the solutions obtained are in general too cumbersome for use in design and approximate solutions are furnished for this purpose.

In Type I it is found that the longitudinal distribution depends primarily on the ratio of the flexural rigidities of the transverse beams and longitudinal diaphragms, the spacing of the transverse beams, and the spacing of the axles in the train of loads. It is possible to reduce the number of variables by a study of the proportions of existing bridges. Suggestions are made as to how this may be accomplished so that a simpler formula may be derived.

In Type II it is found that the lateral distribution depends on two main factors. The first is a dimensionless parameter which is a function of the ratio of the flexural rigidities of transverse members and the longitudinal beams, the length of the bridge and the spacing of the longitudinal beams. The other factor is the total width of the bridge. Approximate expressions are derived giving the maximum moments in the beams for the types investigated.

The analytical results obtained for the longitudinal distribution of loads are compared with test results on actual bridges which were furnished by the Association of American Railroads. Agreement between theoretical and test results are found to be quite good except in those cases where the bridges carried concrete deck plates. Modifications of the results of the thesis are suggested to take approximate account of the effect of such deck plates.

The formulas resulting from the mathematical investigations are summarized in charts and tables in order to facilitate the solution of specific problems.

Finally, recommendations are made for further study along certain specific lines.

VITA

Thein Wah was born on April 11, 1919, in Rangoon, Burma. After graduating from Government High School, Magwe, he entered the University of Rangoon and obtained a Bachelor of Science (Honors) degree in Engineering from that institution in 1941. From 1941 to 1947 he was employed in the Burma Railways as an Assistant Engineer and in the Public Works Department of the Government of Burma as an Assistant Sanitary Engineer. In 1947 he came to the United States for further studies as a state scholar of the Government of Burma. He holds a Master of Science degree in Civil Engineering from the University of Utah (1948) and another Master of Science degree in Civil Engineering from Harvard University (1949). He entered the University of Illionis in February 1950 and held a research graduate assistantship in Sanitary Engineering until February, 1951. From February 1951, until June 1952, for three semesters, he held a University Fellowship.